200. *The Synthesis of 3-Methyl and 3 : 5-Dimethyl* l-*Arabinose.*

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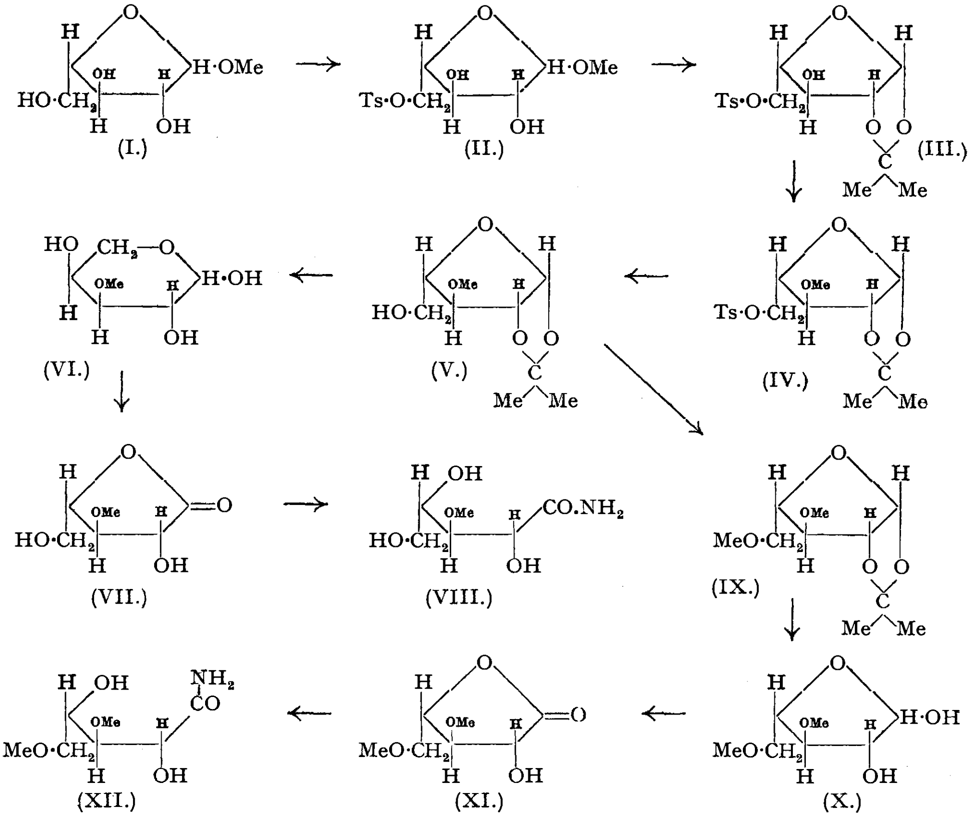
3-*Methyl* l-*arabinose* has been prepared from 5-*p*-toluenesulphonyl 1 : 2-monoacetone *l*-arabinose. It forms a crystalline anilide and on oxidation gives 3-*methyl* l-*arabonolactone*, further characterised as its crystalline *amide*. Methylation of 3-*methyl* 1 : 2-*monoacetone* l-*arabinose* gives 3 : 5-*dimethyl* 1 : 2-*monoacetone* l-*arabinose* which on hydrolysis yields the known 3 : 5-dimethyl *l*-arabinose (White, *J. Amer. Chem. Soc.*, 1946, **68**, 272) which on oxidation gives 3 : 5-dimethyl *l*-arabonolactone, characterised as the crystalline amide and *phenylhydrazide*.

The araban associated with pectin is known to be of the branched chain type (Hirst and Jones, *J.*, 1939, 454) since the methylated derivative gave on hydrolysis three products, namely, 2 : 3 : 5-trimethyl *l*-arabofuranose, 2 : 3-dimethyl *l*-arabinose, and a monomethyl derivative the identity of which was not conclusively established though on the balance of evidence the methyl group was assigned tentatively to the 3-position. This monomethyl arabinose gave on



(Ts = p-SO_2·C_6H_4·Me.)

oxidation a furano-lactone, and since the free sugar had the properties of a derivative of arabopyranose it must be either 2- or 3-methyl *l*-arabinose. The latter possibility was thought to be the correct one since the non-crystalline amide prepared from the crude lactone gave a positive Weerman reaction indicating the presence of an α-hydroxy-amide. The synthesis of 3-methyl *l*-arabinose was accordingly undertaken in order to provide material of known constitution for comparison with that obtained from araban. The starting material in this synthesis was methyl *l*-arabofuranoside (I) (Baker and Haworth, *J.*, 1925, 365) which was converted into the syrupy 5-*p*-toluenesulphonyl derivative (II) by reaction with the calculated quantity of *p*-toluenesulphonyl chloride in dry pyridine. The known 5-*p*-toluenesulphonyl 1 : 2-monoacetone *l*-arabinose (III) [prepared previously from *l*-arabinose diethylmercaptal (Compton and Levene, *J. Biol. Chem.*, 1936, **116**, 189)] was then prepared from (II) by reaction with acetone containing hydrogen chloride. Methylation of (III) with silver oxide and methyl iodide gave 5-p-*toluenesulphonyl 3-methyl* 1 : 2-*monoacetone* l-*arabinose* (IV) which on reductive alkaline hydrolysis (Compton and Levene, *loc. cit.*) gave 3-*methyl* 1 : 2-*monoacetone* l-*arabinose* (V). On acidic hydrolysis this product was converted into syrupy 3-*methyl* l-*arabinose* (VI). This compound formed a crystalline *anilide* on heating with alcoholic aniline and a crystalline *furanolactone* (VII) on oxidation with bromine water. A crystalline *amide* (VIII) was produced on reaction of the lactone with liquid ammonia (cf. Jellinek and Upson, *J. Amer. Chem. Soc.*, 1938, **60**, 356). This amide depressed the melting point of 2-methyl *l*-arabonamide and gave a positive Weerman test indicating the presence of a hydroxyl group on C2.

The monomethyl sugar isolated from the hydrolysis of peanut araban differs from 3-methyl *l*-arabinose and must therefore be 2-methyl *l*-arabinose. This has been subsequently confirmed by the synthesis of 2-methyl *l*-arabinose which was found to be identical with the monomethyl sugar isolated from methylated peanut araban (forthcoming publications).

3-Methyl 1 : 2-monoacetone *l*-arabinose (V) on further methylation gave 3 : 5-*dimethyl* 1 : 2-*monoacetone* l-*arabinose* (IX) which on hydrolysis gave 3 : 5-dimethyl *l*-arabinose (X); this on oxidation gave the corresponding furano-lactone (XI) which was smoothly converted into the α-hydroxy-amide (positive Weerman test) (XII) with liquid ammonia (cf. White, *loc. cit.*) and into the *phenylhydrazide* on heating with alcoholic phenylhydrazine.

EXPERIMENTAL.

5-p-*Toluenesulphonyl Methyl*-l-*arabofuranoside and* 5-p-*Toluenesulphonyl* 1 : 2-*Monoacetone* l-*Arabinose.*—Methyl-*l*-arabofuranoside (31 g.) was dissolved in dry pyridine (250 c.c.) and *p*-toluenesulphonyl chloride (37 g.), dissolved in pyridine (50 c.c.), was added at 20°. Heat was evolved, and the solution was then left overnight (20 hours). Next morning pyridine was removed under reduced pressure at 60°, and the syrupy residue dissolved in chloroform and the solution washed successively with N-sulphuric acid, saturated sodium hydrogen carbonate solution, and water. The chloroform extract [dried (Na_2SO_4) and filtered] was then concentrated under reduced pressure to the syrupy 5-*p*-toluenesulphonyl methyl-*l*-arabofuranoside (36 g.). The syrup (30 g.), without further purification, was dissolved in acetone (300 c.c.) containing dry hydrogen chloride (3 g.). After 70 hours the acetone solution was poured into excess of sodium hydrogen carbonate solution and the arabinose derivative extracted with chloroform. Concentration of the chloroform extracts [dried (Na_2SO_4)] gave 5-*p*-toluenesulphonyl 1 : 2-monoacetone *l*-arabofuranose, m. p. 130°, after recrystallisation from acetone–ether (yield, 21 g.) (cf. Compton and Levene, *loc. cit.*).

5-p-*Toluenesulphonyl 3-Methyl* 1 : 2-*Monoacetone* l-*Arabofuranose.*—5-*p*-Toluenesulphonyl 1 : 2-monoacetone *l*-arabofuranose (5 g.) was methylated by dissolution in methyl iodide (10 c.c.) and portionwise addition of silver oxide. The *product*, isolated in the usual manner, was recrystallised from acetone–light petroleum (b. p. 40—60°). The yield was quantitative, m. p. 101° (Found : C, 53·6; H, 6·1; OMe, 8·4; $C_{16}H_{22}O_7S$ requires C, 53·6; H, 6·2; OMe, 8·7%).

3-*Methyl* 1 : 2-*Monoacetone* l-*Arabofuranose.*—5-*p*-Toluenesulphonyl 1 : 2-monoacetone 3-methyl-*l*-arabofuranose (4 g.) was dissolved in methyl alcohol (50 c.c.) and water (20 c.c.), and sodium amalgam (40 g., 4%) added with stirring at 30° (cf. Compton and Levene, *loc. cit.*). The resultant monoacetone derivative was extracted with chloroform and the extracts were dried ($MgSO_4$) and filtered. Removal of the solvent left crude 3-*methyl* 1 : 2-*monoacetone* l-*arabinose* (1·8 g.), $n_D^{23°}$ 1·4565, which was purified by vacuum distillation; b. p. 120° (bath temp.)/2 mm., $n_D^{23°}$ 1·4572 (Found : C, 52·8; H, 7·5; OMe, 15·5. $C_9H_{16}O_5$ requires C, 52·9; H, 7·8; OMe, 15·2%).

3-*Methyl* l-*Arabinose.*—3-Methyl 1 : 2-monoacetone *l*-arabofuranose (0·73 g.) was dissolved in 20% acetic acid (20 c.c.) and boiled for 3 hours; $[\alpha]_D^{20}$ − 29° (initial value); + 95° (final value). The 3-*methyl arabinose* was isolated as a syrup on concentration of the solution in a vacuum; $[\alpha]_D^{20°}$ + 110° (*c*, 3·6 in water) (Found : OMe, 19·2. $C_6H_{12}O_5$ requires OMe, 18·9%). On being heated with alcoholic aniline (180 mg.) the sugar (111 mg.) gave a crystalline *anilide* (100 mg.), m. p. 117° after recrystallisation from alcohol (Found : C, 60·1; H, 7·3; N, 5·9; OMe, 12·6. $C_{12}H_{17}O_4N$ requires C, 60·2; H, 7·1; N, 5·9; OMe, 13·0%).

No crystalline phenylhydrazone could be isolated. On oxidation of the sugar with bromine water under the usual conditions 3-*methyl* l-*arabofuranolactone* was isolated as a crystalline solid (m. p. 71°) which was purified by sublimation in a vacuum, and then had m. p. 78° (constant value); $[\alpha]_D^{20°}$ − 74° (*c*, 0·34 in water), no observable change in 24 hours (Found : C, 44·3; H, 6·7; OMe, 19·2; equiv., 162.

$C_6H_{10}O_5$ requires C, 44·4; H, 6·2; OMe, 19·1%; equiv., 162). With liquid ammonia the lactone gave 3-*methyl* l-*arabonamide*, m. p. 132°, after recrystallisation from alcohol–acetone (Found: C, 40·3; H, 7·3; N, 7·5; OMe, 17·1. $C_6H_{13}O_5N$ requires C, 40·2; H, 7·27; N, 7·8; OMe, 17·3%). This amide gave a positive Weerman test and depressed the m. p. of 2-methyl *l*-arabonamide.

3 : 5-*Dimethyl Monoacetone* l-*Arabofuranose*.—3-Methyl monoacetone *l*-arabinose (0·8 g.) was methylated with Purdie's reagents and the *product* (0·8 g.), isolated in the usual manner, was distilled under reduced pressure; b. p. 120° (bath temp.)/0·5 mm., $n_D^{22°}$ 1·4420 (Found: OMe, 28·1. $C_{10}H_{18}O_5$ requires OMe, 28·4%).

The above derivative (242 mg.) was boiled with 25% acetic acid (20 c.c.) for 3 hours; $[\alpha]_D^{20°}$ − 39°, unchanged on heating. The solution was concentrated under reduced pressure and the resultant 3 : 5-dimethyl *l*-arabofuranose purified by solution in acetone followed by filtration. The sugar had $n_D^{22°}$ 1·4600 (Found: OMe, 34·6. Calc. for $C_7H_{14}O_5$: OMe, 34·8%).

The sugar (200 mg.) was oxidised with bromine (1 c.c.) in water (5 c.c.) at 20° for 24 hours. Excess of bromine was removed by aeration and the last traces of bromine by passage of sulphur dioxide. The lactone was then removed from the aqueous solution by continuous extraction with chloroform. Concentration of the extracts gave crystalline 3 : 5-dimethyl *l*-arabonolactone, m. p. 73° (after sublimation in a vacuum), depressed to 50° on admixture with 2 : 5-dimethyl *l*-arabonolactone; $[\alpha]_D^{20°}$ − 83° (*c*, 0·12 in water), no observable change in 24 hours (Found: OMe, 33·9; equiv., 169. Calc. for $C_7H_{12}O_5$: OMe, 35·2%; equiv., 176). With liquid ammonia the lactone gave the corresponding amide, m. p. 144° (depressed to 120° on admixture with 2 : 5-dimethyl *l*-arabonamide), which gave a positive Weerman reaction (Found: C, 43·8; H, 7·6; N, 7·0; OMe, 31·2. Calc. for $C_7H_{15}O_5N$: C, 43·5; H, 7·8; N, 7·25; OMe, 32·1%).

The *phenylhydrazide*, m. p. 144° [depressed to 132° on admixture with the phenylhydrazide (m. p. 163°) of 2 : 5-dimethyl *l*-arabonic acid], was prepared by heating the lactone with an alcoholic solution of phenylhydrazine. It was recrystallised from acetone–ether (Found: C, 54·5; H, 6·8; N, 9·8; OMe, 21·6. $C_{13}H_{20}O_5N_2$ requires C, 54·8; H, 7·0; N, 9·9; OMe, 21·8%).

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